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Specification

1. Title of Invention: COATING DEVICE

2. Claim

A coating apparatus which delivers coating liquid from a pipe by pressure-feeding a gas to a storage container in which the coating liquid is stored, a coating apparatus comprising:

a transparent pipe in which at least a part of the pipe is configured of a transparent body and

a sensor which detects the presence of bubbles which are being mixed into the coating liquid which is delivered to the transparent pipe from the storage container.

3. Detailed Description of the Invention

[Industrial Field of Utilization]

The present invention relates to a coating apparatus.

[Prior Art]

Generally, in the manufacture of semiconductors, at a stage of forming a pattern on a thin film which is laminated on a semiconductor wafer, a resist is coated on the semiconductor wafer, the resist is exposed and developed after passing through a mask which is formed on the pattern, etching is performed and the thin film is formed as a pattern shape. A resist coating apparatus or a developing apparatus, which is used in such resist coating or development, drops a certain amount of the resist liquid or the developing solution stored in a storage container from a nozzle onto the semiconductor wafer which is vacuum-contacted on a chuck and is set so as to coat the resist liquid or the developing solution, which is added dropwise on the semiconductor wafer, uniformly on the whole surface by rotating the chuck with a high velocity.

[Problems to Be Solved by the Invention]

However, along with the increasingly high integration of integrated circuits, the influence of uneven coating becomes great. In some cases, the uneven coating is mainly caused by air bubbles being mixed in a resist liquid or a developing solution with a high clay. In addition, it is hard to remove the air bubbles, once the air bubbles are mixed therein. Therefore, efforts are made to remove the air bubbles. In particular, since a gas such as a nitrogen gas is press-fed to a storage container 1 from a pipe 4 in order to deliver the resist liquid or the developing solution 2 from a storage container 1 to a pipe 3 as shown in Fig. 3, when the amount of the resist liquid or the developing solution 2 which remains in the storage container 1 becomes small, it is easy for the air bubbles to be mixed therein. For this reason, a tank 5 is provided in the pipe 3, the amount of the liquid in the tank 5 is detected by a liquid amount sensor 6 and the like, and the leakage of the air bubbles to a nozzle is prevented by detecting the remaining amount of the resist liquid or the developing solution in the storage container 1.

However, when the remaining amount becomes small, the detection of the air bubbles that are apt to be mixed in is not performed, thereby frequently causing an unevenly coated film on the semiconductor wafer. Therefore, the product yield becomes poor.

The present invention is made to solve the problems described above and an object of the invention is to provide a coating apparatus which can detect that there is a small amount of coating liquid remaining in the storage container from which the coating liquid is press-fed to the pipe by the gas and can also immediately detect the air bubbles even when the air bubbles are mixed in the liquid, thereby improving the yield of the products.

[Means to Solve Problems]

In order to accomplish the above object according to the present invention, a coating apparatus, which delivers coating liquid from a pipe by pressure-feeding a gas to a storage container in which the coating liquid is stored, includes a transparent pipe in which at least a part of the pipe is configured of a transparent body and a sensor which detects the presence of bubbles which are being mixed into the coating liquid which is delivered to the transparent pipe from the storage container.

[Action]

At least a part of a pipe of a coating apparatus, which delivers liquid to the outside of a storage container through the pipe connected to the storage container by pressing a gas into the coating liquid stored in the storage container, is formed of a transparent pipe. Sensors such as a light emitting element and a light receiving element are provided in the transparent pipe. When there are air bubbles of a certain size in the pipe, since the amount of light which is incident to the light receiving element is changed by the air bubbles, the detection of the presence of the air bubbles can be performed. When the air bubbles are detected, it is possible to realize that the remaining amount of the liquid in the storage container is small. Therefore, it is possible to supply a certain amount of the liquid in which the air bubbles are not allowed to be mixed into the liquid at all times by supplying the liquid to the storage container. Embodiments

An embodiment in which a coating apparatus according to the present invention is applied to a resist coating apparatus at a semiconductor manufacturing stage will be described with reference to the drawings.

As shown in Fig. 1, a resist coating apparatus 7 mounts and fixes a wafer 8 by vacuum adsorption and a chuck 10 having a disc shaped upper surface and fixed in a rotation axis of a motor is provided. At the upper side of the chuck 10, a discharge nozzle 11, connected to a horizontal moving mechanism, is provided and is disposed so as to be evacuated to the outside of the wafer 8 from the upper side of the chuck 10 in order to perform dummy dispensation. Near the chuck 10, a cup 12 is provided so as to surround the chuck 10 and prevent the surroundings from being scattered with the excess resist from the rims of the wafer 8 when the chuck 10 rotates in order to spread the resist, which is dripped on the wafer 8 from the discharge nozzle 11, to the whole surface of the wafer 8. Moreover, in the lower portion of the cup 12, a discharge port or the like which is connected to a discharge device, not shown, is provided so as to form a gas flow toward the lower portion of the cup 12 in order to prevent the resist which has rebounded from the cup 12 adhering to the wafer 8 again. In addition, when the cup 12 is carried in and out over the wafer 8 and the chuck 10 by a carrying mechanism, not shown, a vertical moving mechanism, not shown, is provided to enable the wafer 8 to be carried in and out easily by lowering a position compared with that shown in the drawings. In order for the

discharge nozzle 11 to prevent dripping of the remaining resist in the discharge nozzle 11 after the resist is dripped, a suck back valve 13 for sucking the remaining resist, a bellows pump 15 which is driven by an air cylinder 14 in order to deliver a certain amount of resist liquid, a water jacket 17 for adjusting a temperature in order to heat a pipe 16 to an adequate temperature, a filter 20 which is connected to a deaeration device 19 via a valve 18, a valve 21, a liquid detecting device 22 and the like are connected to a storage container 24 of a resist liquid 23, which is liquid, via the pipe 16. To the resist liquid storage container 24, a nitrogen gas supply system 26, which is a gas, is linked via a pipe 25.

As shown above, a transparent pipe 27 of which at least a part is configured of a transparent body as shown in Fig. 2 is inserted in the storage container 23 of the resist coating apparatus 7. The liquid detecting device 22, provided in a portion of the transparent pipe 27, includes a sensor 30 which is configured of a light emitting element 28 and a light receiving element 29. It is not limited to a translucent type as shown in the drawings; the light emitting element 28 and the light receiving element 29 may be a reflective type which provides the light emitting element and the light receiving element to the same portion. Regarding the light emitting from the light emitting element 28, since air bubbles 31 are present and mixed in the resist liquid 23, and the air bubbles 31 perform as a lens, the light amount which is incident to the light receiving element 29 is changed. It is possible to detect the inner diameter of the air bubbles 31 of 1mm or less when, for example, the inner diameter of the transparent pipe 27 is 4mm. When the liquid detecting device 22 further detects the presence of the air bubbles 31 in comparison with information in which an input value from the light receiving element 29 is determined in advance by the sensor 30, a CPU which outputs a detecting signal is provided and an alarm sound generating device 32 is provided to make the alarm sound according to an alarm sound generating signal from the CPU.

Hereinafter, actions of the resist coating apparatus 7 having the configuration described above will be described.

By lowering the position of the cup 12 compared with that of the drawings, the wafer 8 is carried in by the carrying mechanism, not shown, on the chuck 10. The cup 12 reaches a state capable of coating by escalating the cup 12 compared with the position shown in the drawings. The discharge nozzle 11 is moved to the upper side of a middle portion of the wafer 8 by the horizontal moving mechanism and the resist liquid is supplied. By inserting the pipe 25 in the storage container 24 of the resist liquid 23 from the nitrogen gas supply system 26, nitrogen gas is pressed into the storage container 24 from the pipe 25. The resist liquid 23 is press-fed to the transparent pipe 27 from the storage container 24. When a sufficient liquid amount of the resist liquid 23 in the

storage container 24 is secured at this time, the resist liquid is delivered without the air bubbles 31 being mixed into the resist liquid 23. If the air bubbles 31 are not detected by the sensor 30, the resist liquid 23 is continuously delivered to the transparent pipe 27. The resist liquid is heated to an adequate temperature by the water jacket 17 via the valve 21 and the filter 20 and supplied to a bellows pump 15. In the filter 20, particles mixed in the resist or very fine air bubbles, which may not be detected by the sensor 30, are filtered and removed by the deaeration device 19. A predetermined amount of the resist liquid 23, which is supplied to the bellows pump 15, is delivered to the pipe 16 by the bellows pump 15 driven by the air cylinder 14 and the resist liquid 23 is dripped onto the wafer 8 on the chuck 10 from the discharge nozzle 11. Subsequently, the remaining resist liquid is sucked without being dripped from the discharge nozzle 11 by the suck back valve 13 and the dripping on the wafer 8 is prevented. The chuck 10 is rotated at a high velocity by a motor 9 and the resist is coated. After the coating is completed, the cup 12 is lowered, the carrying in and out of the wafer 8 is performed and the process described above is repeated. If the resist liquid 23 in the storage container 24 is used up and the remaining amount becomes very small, when the air bubbles 31 in the transparent pipe 27 occur, the amount of light with which the light emitting from the light emitting element 28 is incident to the receiving light receiving element 21 is changed and a detecting signal of the air bubbles is delivered to the CPU by the sensor 30. The CPU outputs the alarm sound generating signal to the alarm sound generating device 32 and makes the alarm sound. By this, an operator is notified that the remaining amount of the resist liquid 23 in the storage container 14 is low and the operator fills the resist liquid 23 into the storage container 24 by closing the valve 21. The gas being mixed in the pipe is removed by closing the valve 21 and by the deaeration device 19 which is connected to the filter 20 and the resist coating is performed again. Along with the detection of the air bubbles, it may add contrast by providing a filter of an appropriate color when photoelectric detection of the transparent pipe 27 is performed.

According to the present invention, in the related art, since the detection of the air bubbles is not performed, the operator may not be notified if they do not see the remaining amount directly. However, since the operator may be notified by detecting means, work efficiency may be dramatically improved and the problems of the uneven coating caused by the resist liquid containing the air bubbles and coated onto the wafer and the poor yield caused by the uneven coating can be solved as well.

The explanation above is an embodiment of the coating apparatus according to the present invention and the invention is not limited to the resist coating apparatus. If a coating liquid which is supplied from a storage container is used, for example, it may be applied to every kind of apparatus for a coating developing solution. In particular, it is

preferably applied to apparatuses which use liquid having a high viscosity for which it is difficult to remove the admixed air bubbles. Furthermore, it is preferably applied to an LCD substrate, a print substrate and the like.

[Advantages of the Invention]

As can be seen from the above explanation, according to a coating apparatus of the present invention, when the coating liquid in the storage container is supplied by pressing of a gas, since sensing whether the remaining amount is low is performed by means for detecting air bubbles being mixed into the coating liquid and means for notifying an operator is provided, the coating liquid can be prevented from being mixed with the air bubbles and filling the liquid amount can be properly performed, if necessary.

[Brief Description of the Drawings]

FIG. 1 is a configuration diagram illustrating an embodiment of a coating apparatus according to the present invention.

FIG. 2 is a diagram illustrating a main portion of the embodiment in Fig. 1.

FIG. 3 is a diagram illustrating a conventional example.

- 16 pipe
- 22 liquid detecting apparatus
- 23 resist liquid (gas)
- 24 storage container
- 26 nitrogen gas supply system (gas)
- 27 transparent pipe
- 30 sensor

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